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ABSTRACT

Reported is an observational analysis process termed "macroanalysis" which involves the analysis of interactive dialogue in chains or sequences of coded behavior rather than in terms of conventional matrices and ratios. All existing 3-, 4-, and 5-tally chains are extracted directly from an observer's coded tallies. This paper includes a presentation of the Campbell-Rose Interaction System, a definition and discussion of units of dialogue and of discussion catalysts (which include what Rowe calls "wait-time"). A list of 13 references is also included. (PEB)

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MACROANALYSIS: A STEP TOWARD THE DEVELOPMENT OF DISCUSSION CATALYSTS AND INSTRUCTIONAL MODELS

by

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Paper delivered at the Forty-seventh Annual Meeting of the National Association for Research in Science Teaching in Chicago, Illinois, on April 16, 1974

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Macroanalysis is the process of analyzing interactive dialogue in chains or sequences of coded behavior rather than in terms of the conventional matrices and ratios. This process was initially used with interactive data accumulated with the Flanders Interaction Analysis System (FIAC) and the Campbell-Rose Interaction System (CPIS). More recently it has been used with more diverse interactive systems.

Macroanalysis is a descriptive process which extracts all existing three-, four-, and five-tally chains directly from an observer's coded tallies. No matrices are used to derive the patterns, and consequently no inferences are involved. The process views teaching not from "microscopic" three- or six-second time sequences (one-two tallies), but from larger and larger groupings of data. The term "macro" was coined to describe the increasing scope of the analysis. The focus of the analysis is directed toward chains of varying length.

The macroanalysis approach is not new to the field of observation analysis. Kliebard (1963) and Bellack and Davitz (1963), described interactive data in terms of chains of varying lengths and called them teaching cycles. Kliebard defines a teaching cycle "as a unit of classroom discourse which is initiated by a structuring move or a solicitation which is not preceeded by a structuring and ending with the move that proceeds a new structuring or a new unstructured solicitation."

Kliebard developed twenty-one teaching cycles from specific sequences of Bellack's four pedagogical moves (Structuring, Soliciting, Responding, Reacting). He analyzed the interactive dialogue of a sample of senior high school social studies teachers in terms of their teaching cycles. The three variables utilized in this analysis were: (1) the kind of cycle, (2) the rate (number of cycles used per minute), (3) in terms of initiator - pupil or teacher. He found that this group of teachers used only six of the cycles to any appreciable degree. Most of the other twenty-one cycles were rarely used by the teachers. Thus the Kliebard-Bellack teaching cycle approach did not result in any extensive set of useable teaching cycles. Their contribution lies in the realization that larger units of

dialogue are important elements of the classroom interaction. The macroanalysis process used their research as a starting point but did not limit the analysis in any way. Macroanalysis uncovers all existing cycles. Consequently, our own research studies have uncovered as many as 2,500 to 3,500 different three-tally patterns, 5,800-8,400 different four-tally patterns, and 9,000-13,000 different five-tally patrerns for various groups of junior and senior high school teachers. These patterns are the focal point of the macroanalytic process. They provide more fertile territory for continued development in this area.

Other researchers have used patterns with interactive data tabulated with the FIAC. Amidon and Amidon (1967), Hall (1969), Evans (1969), DeLucia (1971), and Bosch (1972) all investigated patterns but did so on an inferential basis. They derived their patterns from matrices. Campbell (1973) pointed out that this inferential process was of questionable validity. Schrable and Minnis (1969) also illustrated a series of patterns of varying lengths. They hypothesized that such patterns appeared to be important but were unable to develop a mechanism for quantifying them.

Macroanalysis does eliminate this problem by not utilizing any interactive matrices.

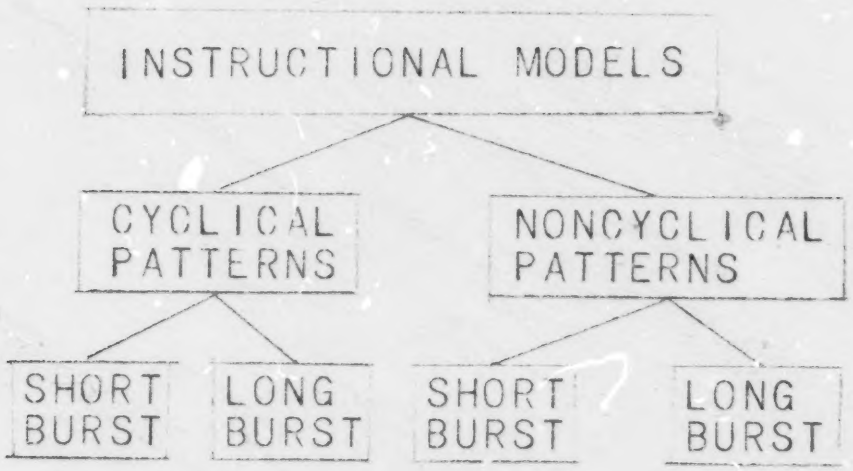
UNITS OF DIALOGUE

The macroanalysis process has several distinct units of dialogue (refer to Figure 1). The smallest unit is the burst. Short bursts are defined as behaviors which last for a maximum of three seconds. The term "burst" was derived from the research of Rowe (1972). Another way to define this term is by the units X-A-X, where X is any other category other than "A." The category "A" is the short burst, and it is surrounded by other categories (X). The short bursts are always one tally in length. Long bursts, X-A-A-X, are defined as any repetitive behavior (A-A) which is surrounded by two other categories. The long bursts are always two tallies in length and last for six seconds if using the Flanders timing sequence.

In order to illustrate how bursts are derived from interaction data, we have developed an array of twenty FIAC tallies in Figure 2. The arrows from the array

FIGURE 1

UNITS OF DIALOGUE



illustrate the first four bursts. The first short burst is X-4-X,and the first long burst is X-5-5-X. Figure 2 also contains a summary of all the bursts derived from this array. It is obvious that this sample array is made up entirely of bursts. Longer sequences are not evident.

The second major unit of dialogue is the pattern. It is defined as any combination of three or more tallies. In most cases patterns are made up of combinations of long and short bursts. There are two kinds of patterns - noncyclical and cyclical. A noncyclical pattern begins and ends with a different category (X-A-B-C-X; X-A-B-C-D-X). A cyclical pattern begins and ends with the same category (X-A-B-A-X). Figure 3 contains the same array of coded tallies as shown in Figure 2, but the analysis is done in terms of patterns. Notice that the first pattern is a noncyclical 4-8-3 pattern which turns out to be the most dominant pattern in this array. Most of these patterns are noncyclical. Only the 4-8-3-4 pattern begins and ends with the same category. This is a cyclical pattern because it begins and ends with a teacher's question (4).

The final unit of dialogue is the instructional model. This grouping is defined as any combination of two or more patterns. Again,cyclical and noncyclical models exist. In order to illustrate just how the instructional models are developed from patterns, we have provided two examples in Figure 4. The category numbers are categories of the Campbell-Rose Interaction System (CRIS). CRIS is a subscripted Flanders system and is shown in Table 1. The first digit of this system corresponds to the ten categories in the FIAC.

Our first model in Figure 4 shows the combining of four different patterns into one noncyclical grouping. This model combines the teacher's questions on cognitive memory (41) and convergent (42) levels, a brief response on the student's part (81), and the teacher's use of student ideas in two ways. This model is a more detailed form of the common FIAC 4-8-3 pattern.

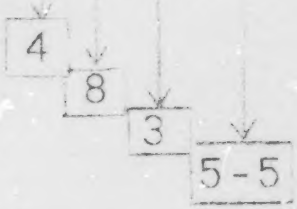
The second model illustrated in Figure 4 contains eight patterns which are combined into a simplified divergent discussion model. This high level pattern involves the use of both short bursts and long bursts of divergent questions (43),

FIGURE 2

BURSTS

Flanders-FIAC-tallies

10-4-8-3-5-5-4-8-3-4-5-4-4-8-3-4-4-8-3-10



DOMINANT SHORT BURSTS

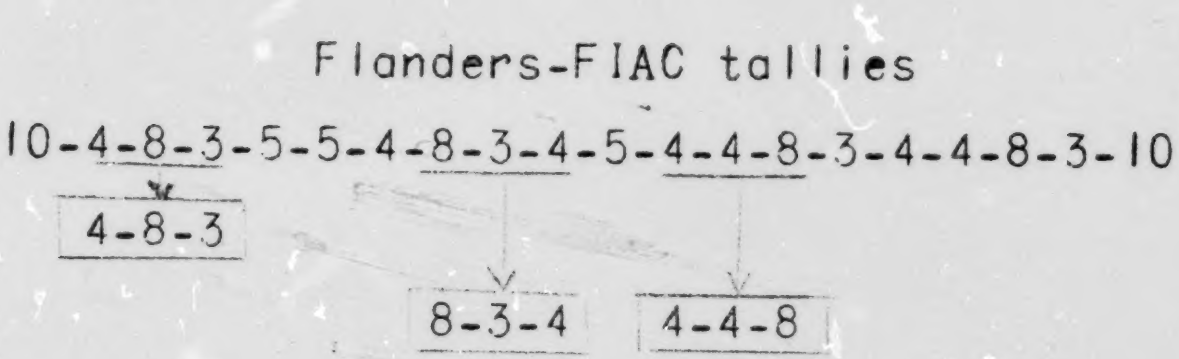
Bursts	fo	%
X-3-X	4	100
X-4-X	3	43
X-5-X	1	33.3
X-8-X	3	75
X-10-X	2	100

DOMINANT LONG BURSTS

Bursts	fo	%
X-4-4-X	2	57
X-5-5-X	2	66.6

FIGURE 3

PATTERNS



DOMINANT NONCYCLICAL PATTERNS

Patterns	fo
4-8-3	4
8-3-4	2
4-4-8	2
4-4-8-3	2

DOMINANT CYCLICAL PATTERNS

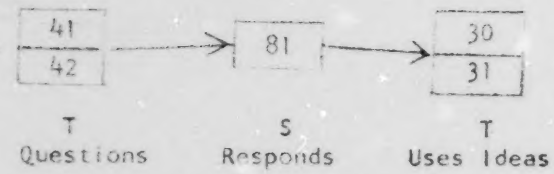
Patterns	fo
4-4-3-4	2

FIGURE 4

INSTRUCTIONAL MODELS

Low level Model

41-81-30
41-81-31
42-81-30
42-81-31



High level Model

43-00-93
43-43-00-93
43-43-93
43-93-93
43-00-93-93
93-00-93
93-93-00-43
93-93-43

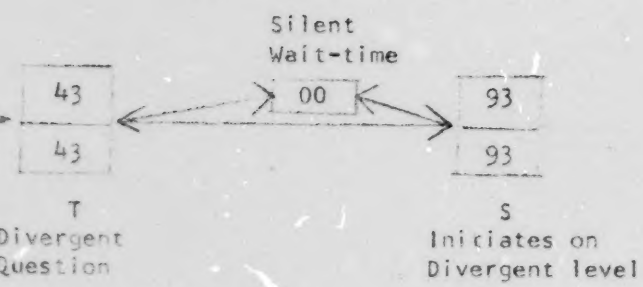


TABLE 1

Campbell-Rose Interaction System

Developed by
James Reed Campbell and Ryda D. Rose

Teacher Behaviors

11 Teacher accepts student feelings or utilizes student emotion.
20 Teacher uses short praise.
21 Teacher encourages - short response
25 Teacher uses praise with reasons.
30 Teacher accepts or uses student ideas--short response.
31 Teacher accepts or uses student ideas--descriptive level.
32 Teacher accepts or uses student ideas--inferential level.
33 Teacher accepts or uses student ideas--generalization level.
34 Teacher turns student ideas into a question for the class.
41 Teacher asks cognitive memory question.
42 Teacher asks convergent question.
43 Teacher asks divergent question
44 Teacher asks evaluative question.
54 Teacher asks rhetorical question--no answer accepted.
55 Teacher lectures or gives his own opinion.
60 Teacher gives directions.
71 Teacher criticizes or rejects student answers--short response: "No," "Wrong," "That's not right."
72 Teacher rejects student ideas with reasons.
73 Teacher criticizes or rejects student feelings or emotion--short response (disciplinary teacher behavior).
74 Teacher criticizes or rejects student feelings or emotion with reasons (disciplinary teacher behavior).

Student Behavior

81 Student responds to teacher-initiated question on low level (cognitive memory or convergent level).
91 Student initiates question or comment on cognitive memory level.
92 Student initiates question or comment on convergent level.
93 Student initiates question or comment on divergent level.
94 Student initiates question or comment on evaluative level.
97 Student initiated argumentation (disciplinary backtalk).
00 Silence
01 Nonproductive confusion.
02 Productive confusion.

(43-43), wait time(00), and both long and short bursts of student dialogue on the divergent level(93 - 93). Notice the arrows can be cyclical and terminate with the same categories that initiated the model. This model involves both wait-time following a teacher's questions (43 - 00) and also following a student's responses (93 - 00).

With the units of dialogue defined, let us proceed to discussion catalysts.

DISCUSSION CATALYSTS

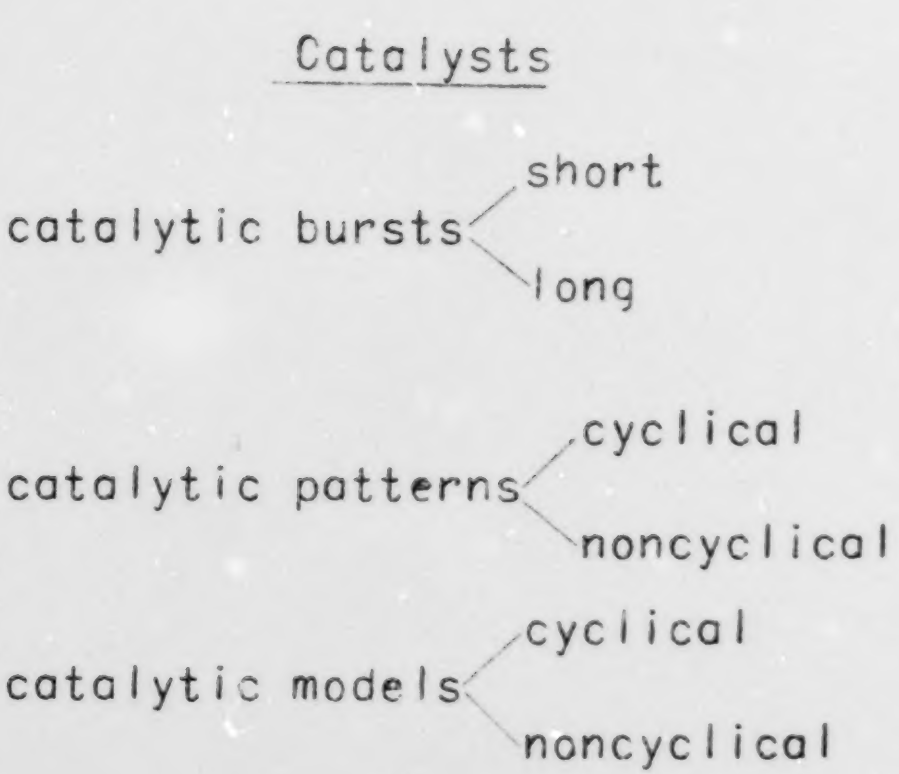
A discussion catalyst is defined as any macroanalytic unit of dialogue which facilitates classroom discussion. It can exist in bursts, patterns, or models (Figure 5). In all cases it encourages discussion. The term catalyst was derived from enzyme terminology. In this sense catalysts speed up the time needed to complete a reaction. If a catalytic enzyme is missing, the reaction proceeds so slowly that it is never completed in time. The same may be true for classroom discussion catalysts.

Classroom discussions are invariably initiated by a teacher's or student's questions, but questions alone cannot sustain a good discussion. Questions are vital to get discussions started, but they cannot be used indefinitely without some degree of artificiality. Discussions need to be built on teacher behaviors which encourage the participants to interact on higher cognitive levels with each other. It is the contention of this paper that catalysts are needed to facilitate discussions. Without them good discussions cannot be maintained. Discussions are designated productive when a good volume of student initiated dialogue is generated, particularly on divergent and evaluative levels. Another facet of good discussions is an abundance of student-to-student interaction without intervening remarks by the teacher.

We have identified four different sets of catalysts:

1. Wait-time Catalysts
2. Catalytic couplets — TS / ST
3. Catalysts which involve changing or maintaining the cognitive level of dialogue.
4. Indirect Catalysts

FIGURE 5


Catalysts
catalytic bursts
short
long
catalytic patterns
cyclical
noncyclical
catalytic models
cyclical
noncyclical

Wait-time catalysts were developed by Rowe (1972). They involve using bursts of silence following a teacher's question or following the termination of a student statement. Rowe found that when teachers used wait-time catalysts the dialogue was affected in the following ways:

> "1. The length of responses increases. 2. The number of unsolicited but appropriate responses increases. 3. Failure to respond decreases. 4. Confidence as reflected in decrease of inflected responses increases. 5. Incidence of speculative responses increases. 6. Incidence of child-child comparisons of data increases. 7. Incidence of evidence-inference statements increases. 8. The frequency of student questions increases. 9. Incidence of responses from students rated by teachers as relatively slow increases."

The second set of catalysts are the catalytic couplets. These couplets were first recognized by Amidon and Amidon (1967). They emerged from their pattern analysis process and were designated "Teaching Patterns." According to the Amidons, a teaching pattern is identified when a complete teacher-student-teacher transaction is identified. Unfortunately, the process Amidon and Amidon used to extract the teaching patterns was found to be inaccurate and, in some cases, invalid (Campbell, 1973). In lieu of Amidon's term, we have named these patterns T-S-T catalysts. The "T's" stand for any teacher category, and the "S" stands for any student category. The T-S-T catalysts are made up of two ST couplets. Due to the presence of two teacher categories in this three-tally pattern, it is heavily teacher dominated.

Very few T-S-T catalysts have emerged from our research studies.

1. $\underset{\text{T}}{4} \longrightarrow \underset{\text{S}}{8} \longrightarrow \underset{\text{T}}{3}$

   Questions Responds Uses ideas

The most dominant T-S-T catalyst is the familiar 4-8-3 pattern. This FIAC pattern involves a brief teacher question, a brief student response, and the teacher's brief use of the student's idea. We have found this pattern in low and high ability classes at both junior and senior high school levels. The pattern seems to be most widely used with junior high school groups.

2. $\underset{\text{T}}{\overline{\frac{41}{42}}} \longrightarrow \underset{\text{S}}{\overline{\frac{91}{92}}} \longrightarrow \underset{\text{T}}{\overline{\frac{30}{31}}}$

   Questions Initiates Uses ideas

Another permutation of the 4-8-3 pattern involves the use of cognitive memory (41) (91) and convergent (42) (92) dialogue on both teacher and student levels. This model is different because it involves the initiation of student behavior. This catalytic model was found to be more prevalent with high school social studies teachers than with their junior high school counterparts. Still this model does not involve any sustained student dialogue. It does involve a variation in the questioning and a higher level of student response, but the teacher's use of this information is similar.

3. 55 (T Lectures) → 91 (S Initiates) → 55 (T Lectures)

Another commonly found T-S-T pattern is the cyclical pattern 55-91-55. Invariably this pattern involves the student's asking the teacher a question within a teacher's lecture sequence.

Although the center student category in this pattern does provide an opportunity for the teacher to change the focus of the dialogue, this does not occur too frequently. Our own sample of teachers seems more inclined to answer the student question or comment by long chains of their own opinion. This is not the case with the S-T-S patterns. Here we have found some very effective catalysts.

4. 91 / 92 (S Initiates) → 34 (T Clarification Question) → 91 / 92 (S Initiates)

This cyclical catalyst is a powerful stimulus to discussion. The 91-34-91 and 92-34-92 patterns both involve CRIS categories, and both utilize the teacher's use of a clarification question (34). These patterns help sustain dialogue at the same cognitive level. Our research indicates that such catalysts cause the student to explain thoughtfully his ideas and in so doing, to increase the volume of student dialogue. These catalysts are frequently found amid long chains of student dialogue.

5. 91 / 92 (S Initiates) → 41 / 42 (T Questions) → 91 / 92 (S Initiates)

We have uncovered a similar cyclical catalyst in the 91-41-91 or 92-42-92 patterns. This model differs only in the nature of the question. In this case the

cognitive memory or convergent question is the teacher's own question, whereas the clarification question involves using the student's ideas to formulate the question. In a very real sense, the clarification question originates with the student's own ideas. Again, these patterns can be used amid longer student sequences.

6. 91 → 55 → 91
S Initiates — T Lectures — S Initiates

Another S-T-S catalyst which emerged in our high school samples was the 91-55-91. This pattern allows the teacher to add information without disrupting the student dialogue. Notice this information is not in the form of correction or rejection but in simply adding further information.

7. 94 → 30 → 94
S Initiates — T Uses ideas — S Initiates

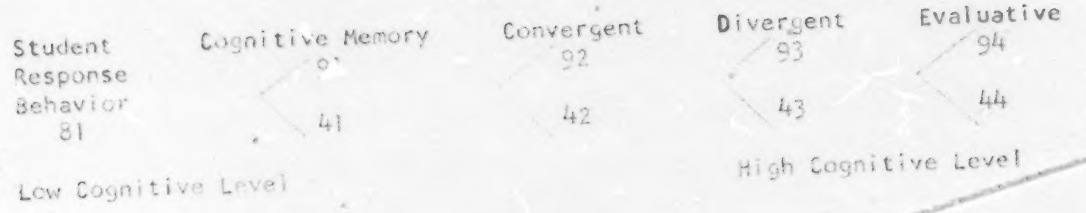
Another S-T-S catalyst which emerged only in senior high school dialogue was the 94-30-94 pattern. This pattern involves very high level student-initiated dialogue on an evaluative level with the teacher simply saying, "yes," or showing some sign of approval for continued dialogue. This verbal cueing is doubtlessly important to keep the discussion going.

8. 81 → 60 → 81
S Responds — T Directions — S Responds

9. 81 → 71 → 81
S Responds — T Directions — S Responds

The final two S-T-S patterns we found in lower ability classes in junior high school samples. They involve a low level of student response behavior and the teacher's use of directions or rejections. Both patterns are negative in nature and would seem to sustain low level dialogue.

The next set of catalysts involves the maintainance or changing of the cognitive level of the dialogue. By using CRIS's levels of questions and student initiated categories, we have derived the following hierarchy:



These catalytic couplets involve teacher and student statements which either maintain the same cognitive level or step-up or step-down the level of dialogue. Thus the couplets 43-93 and 41-91 involve no change in level - they are maintainance catalysts. However, the couplets 41-93 and 91-43 both involve stepping-up the level of the dialogue. In the first step-up couplet the student steps-up the dialogue; in the second couplet the teacher steps-up the dialogue. If we reverse these couplets we have two examples of step-down catalysts 93-41 and 43-91 .

The idea of stepping the dialogue up or down originated with Shrable and Minnis (1969) and their Cognitive Levels Analysis Interaction Model (CLAIM). Their model involved three cognitive levels: 1. Data recall, 2. Data processing, and 3. Application. It is interesting to note that CLAIM was constructed within the conceptual framework of the Taba (1963) research studies. Shrable and Minnis were among the first to speculate on several specific patterns which could result in changing or maintaining the cognitive level of the dialogue.

Our own research studies show very few changes in the cognitive level of the dialogue. This may be due to the heavy dominance of cognitive memory and convergence in our sample classes. Teachers will need training before they can readily change the cognitive level of their classes. It should be interesting to explore what happens when students step-up or step-down the level of the dialogue. Will teachers recognize these changes and maintain the new level?

Another interesting area for research involves the analysis of patterns where students abruptly lower the level of the dialogue. Shrable and Minnis suggest that such student step-down patterns may indicate that students are not ready for dialogue at higher levels. They may use these patterns to cue their teachers accordingly. What happens when teachers try to raise and lower the levels? Will their

students be able to sustain these levels? In all cases we need to determine the effect of these catalysts on the resulting discussions.

The fourth set of catalysts involves indirect teacher behavior. When indirect behavior is added into the dialogue, we have observed that discussions seem to proceed more productively. This is certainly evident when teachers use clarification questions. Whenever a pattern contains such a question (34), we have observed a much greater tendency for student response on higher cognitive levels. Rarely does this catalyst result in low level response behavior (81). Furthermore, in our own research studies, one-third of the patterns using this type of question contain longer chains of student dialogue. Thus students react to this type of indirect teacher behavior by speaking longer and on higher cognitive levels. Similar findings are also evident for the other CRIS subcategories which involve the teacher's use of student ideas.

SUMMARY

Macroanalysis is a process of analyzing interactive data into larger and larger groupings. The units of dialogue involve bursts, patterns, and models. These units can better be understood in a game context (Bellack, 1963). If we utilize this framework, then the three macrounits can be visualized accordingly:

1. Models - Game Plans
2. Patterns - Plays
3. Bursts - Individual Interactions

Such a model does seem to fit the classroom situation. In athletic contests or games two teams interact. Individual players carry out specific assignments (bursts) which are part of larger groupings called plays (patterns). These units are further organized into larger groupings in the form of game plans. A game plan involves a coach's overall strategy - his defensive plays and his offensive plays. An element of chance is always involved in such games, and the interaction of competing strategies and game plans provides the spontaneous element to athletic contests. There are many similarities to classroom dialogue. Each teacher's class is a separate game; each has its own game plan; each involves many plays and individual interactive

assignments; and each involves an element of chance when the varied participants interact in the class.

Certainly, instructional models are broad enough to be considered game plans. Like any such plans, the reaction of the audience may cause the teacher to modify or even abandon the plan. Certainly, athletic teams develop specific game plans and modify them in response to specific problems during the game. In many cases, the quality of the coach is determined by his ability to either apply the game plan despite temporary setbacks or to modify it in direct response to his opponent's strategy. His adaptability during the game is a key factor in his success or failure. Similarly, teachers must develop their interactive game plans for each kind of lesson. This plan also must be modified according to specific problems which arise during the course of the lesson. The teacher must be able to implement effectively the plays needed to achieve his game plan. Doubtlessly, teachers, as do athletes, need to practice their plays repeatedly before they can use them under stressful game conditions. Teachers need to develop their own book of plays and models. As pre-service teachers they need to develop this varied repertoire. Some plays may work well with young children, while others may be useful only with older youngsters. Some will be optimal with high ability students - others will be useful only for slow youngsters. The better the teacher, the larger will be his book of plays and game plans.

Furthermore, we, as educators, should be committed to developing a wide variety of game plans and plays in areas similar to those indicated in Figure 6. In each area numerous game plans could be developed and translated to teachers. Prerequisite plays would also accompany each game plan.

Teachers would also be trained to recognize the emergence of student-initiated plays and to use them effectively. Catalysts are critical plays in the game, and they would need special attention in the initial training of teachers. Teachers would learn their plays and catalysts in microteaching modules.

The classroom game is won only when the students achieve some cognitive or affective goal. If the game plan results in such achievement, the students and

FIGURE 6

Sets of Game Plans

1. Drill
   - Sharp focus
   - Limited feedback
2. Informational
3. Probing or exploration
4. Invention
5. Discovery
6. Discussion
   - Convergence
   - Divergence
   - Evaluative

their teacher win. Similarly, the coach of any team only wins when his team wins. Teachers lose when the students fail to achieve the intended goals. Productive and effective teaching is certainly a team effort, and the classroom game approach will give teachers the interactive tools they need to succeed.

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